

What is claimed is:

1. An apparatus for spin forming a portion of a  
5 workpiece, comprising:

a carrier rotatable about a spin axis;

at least a first roller and a second roller  
10 operatively supported on said carrier, said first roller  
being radially and axially offset from said second roller,  
said first and second rollers radially movable toward and  
away from the spin axis;

15 a rotational drive mechanism for spinning said  
carrier about a spin axis;

a radial drive mechanism for radially translating  
said first roller and said second roller toward and away  
20 from the spin axis to position said rollers for a forming  
pass;

an axial drive mechanism for reciprocating one of  
said first and second rollers or workpiece along a spin  
25 axis to sequentially engage said first roller and then said  
second roller to the workpiece where said first roller and  
said second roller sequentially reduce the diameter of a  
portion of the workpiece during a forming pass.

30 2. The apparatus of claim 1, wherein said axial  
drive mechanism continues to reciprocate until a desired  
reduction in diameter is achieved.

3. The apparatus of claim 1, wherein said radial drive mechanism translates said rollers in unison.

5 4. The apparatus of claim 1, wherein said first roller and said second roller sequentially reduce the diameter of a portion of the workpiece to achieve a desired diameter with a minimum number of forming passes.

10 5. The apparatus of claim 1, wherein said radial drive mechanism positions said first and second rollers before said axial drive mechanism sequentially engages said first roller and then said second roller to a first end of the workpiece.

15 6. The apparatus of claim 5, wherein said radial drive mechanism causes said first roller and said second roller to radially translate inward by an equivalent radial distance prior to a subsequent forming pass.

20 7. The apparatus of claim 1, wherein said first roller reduces the diameter of a portion of the workpiece from a first diameter to a second diameter and said second roller reduces the diameter of a portion of the workpiece  
25 from a second diameter to a third diameter.

8. The apparatus of claim 1, wherein said rollers translate inwardly in calculated steps.

30 9. The apparatus of claim 7, wherein the change in diameter between the first diameter and second diameter is about equivalent to the change in diameter between the

second diameter and third diameter.

10. The apparatus of claim 5, wherein after a first forming pass, said radial drive mechanism radially  
5 translates said first roller from a first radial distance to a third radial distance, relative to the spin axis, where the first radial distance is greater than the third radial distance, and said second roller from a second radial distance to a fourth radial distance, relative to  
10 the spin axis, where the second radial distance is greater than the fourth radial distance.

11. The apparatus of claim 1, wherein said axial drive mechanism reciprocates said rollers toward the  
15 workpiece.

12. The apparatus of claim 11, further comprising a fixture for constraining the workpiece.

20 13. The apparatus of claim 1, wherein said radial mechanism is an external actuation device.

14. The apparatus of claim 1, wherein said radial drive mechanism is an internal actuation device.  
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15. The apparatus of claim 1, wherein said radial drive mechanism is operable to translate said first roller and said second roller while said rotational drive mechanism is spinning said carrier.  
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16. The apparatus of claim 1, wherein the amount of reduction in a single forming pass is a function of the

number of rollers.

17. The apparatus of claim 1, wherein the portion of  
5 the work piece is reduced from an original diameter to a  
final diameter on a single apparatus.

18. The apparatus of claim 1, wherein the number of  
forming passes to achieve a desired reduction in diameter  
10 during a forming operation is a factor of about the number  
of rollers.

19. The spin forming apparatus of claim 12, wherein  
the axis of the non-processed portion of the workpiece is  
15 at an oblique angle relative to the spin axis.

20. A method of spin forming a portion of a  
workpiece, comprising the steps of:

20 spinning at least a first roller and second roller  
about a spin axis where the first roller is radially and  
axially offset from the second roller;

commanding the first roller and second roller to  
25 translate radially to position the rollers for a forming  
pass; and

commanding a forming pass, wherein one of the rollers  
or workpiece travel along the spin axis to engage the first  
30 roller and then the second roller to the workpiece to  
sequentially reduce the diameter of a portion of the  
workpiece to create a formed portion.

21. The method of claim 20, wherein the diameter of a portion of the workpiece is sequentially reduced until a  
5 desired diameter is achieved.

22. The method of claim 20, wherein the diameter of a portion of the workpiece is sequentially reduced by a plurality of forming passes during a forming operation  
10 until a desired diameter is achieved.

23. The method of claim 20, wherein the rollers are commanded to radially translate toward the spin axis by calculated steps before a forming pass.  
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24. The method of claim 20, wherein the amount of reduction in a single forming pass is a function of the number of rollers.

20 25. The method of claim 20, wherein the portion of the work piece is reduced from an original diameter to a final diameter on single apparatus.

26. The method of claim 20, wherein the rollers are  
25 commanded to spin while commanded to radially translate.

27. The method of claim 20, wherein the number of forming passes to achieve a desired reduction in diameter during a forming operation is a factor of about the number  
30 of rollers.

28. The method of claim 20, wherein the workpiece is

positioned for forming whereby the axis of the unprocessed portion of the workpiece is at an oblique angle relative to the spin axis.